3121A
FREQUENCY
SELECTIVE VOLTMETER

RYCOM
INSTRUMENTS

RYCOM INSTRUMENTS
Railway Communications Inc.
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Raytown, Missouri 64133

3121A
FREQUENCY
SELECTIVE VOLTMETER

Serial No. 748

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Addendum - 3121A Selective Voltmeter

The following items are corrections or additions to the manual.

I Selective Voltmeters with 100 Hz Selectivity

1. This manual was written for units with 250 Hz Selectivity. To adapt this manual to units with 100 Hz Selectivity, substitute 100 Hz in portions of the manual where "250 Hz bandwidth","250 Hz bandpass", "Selectivity to 250 Hz", and similar references appear.

2. The 100 Hz Selectivity specifications are: 100 Hz ± 25 Hz at 3 db down.
   400 Hz maximum at 60 db down.

II Corrections and Additions

~~Page I Change manual Part No. 3121A-340A to 3121A-350W Add 1~~

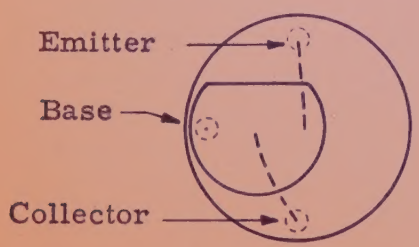
Pages 18, 28, 29, 36 & Figure 13 - Schematic Diagram

Serial No. 637 up with 250 Hz Selectivity, A4Q6 may be RC3710 or 2N4124

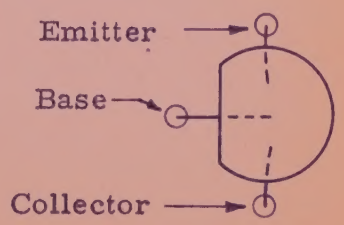
Serial No. 631-636 with 100 Hz Selectivity, change A4Q6 from RC3710 to 2N4124

Serial No. 652 up with 100 Hz Selectivity, change A4Q1 thru A4Q8 from RC 3710 to 2N4124

The lead configuration and installation of the 2N4124 differs from that of the RC3710. See detail below for differences.



RC3710



2N4124

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3121A SELECTIVE VOLTMETER
SER NO
FREQUENCY KHz
RYCOM
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RAYTOWN MO
CAL LEVEL
TUNING
BAND SELECTOR
ATTENUATOR
DB VOLTS
VOLTS DB
10 +20
INPUT
75 Ω
135 Ω–TERM
600 Ω
BRIDGE
CAL
INPUT SELECTOR
2.5KHz
250Hz
SELECTIVITY
HEADSET
PULL ON
AUDIO LEVEL
AM
LSB
USB
MONITOR
BATTERY TEST
115 VAC

Figure 1

CERTIFICATION

The RYCOM Instruments Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory.

WARRANTY AND ASSISTANCE

All RYCOM Instruments Products are warranted against defects in material and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed below for the specified period we will repair or replace products that prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

Exceptions in our products using dry batteries or Ni-Cad batteries the above warranty applies to the equipment only. Ni-Cad batteries are subject to original manufacturers inspection.

Where it is necessary to return the instrument to the factory, furnish information to the nature of trouble encountered. Ship prepaid to:

RYCOM INSTRUMENTS
9351 East 59th Street
Raytown, Missouri 64133

Attention: Service Department

CHAPTER I

GENERAL

1. SCOPE.

This manual describes the RYCOM Model 3121A Frequency Selective Voltmeters. It is battery operated requiring 115 VAC power for battery charging.

The 3121A Frequency Selective Voltmeter is intended for general use where it is desired to measure the level of individual or a narrow band of frequencies.

Table 1 lists the specifications and Table 2 lists the operating controls and indicators for the Voltmeter. Figure 1 shows a photograph of the Voltmeter.

2. DESCRIPTION

The Voltmeter is a fully transistorized battery operated instrument that measures voltage from 7.75 microvolts to 9.75 volts (-100 DBM to +22 DBM) in a frequency range of 1 KHz to 1.5 megahertz. The Voltmeter has a 250 hertz bandwidth filter that makes it particularly useful for analyzing complex wave forms, determining carrier system levels and checking amplitude modulation percentages. It also has a 2.5 KHz bandwidth filter for measuring single sideband carrier noise and for suppression of unwanted signals. Special features include an internal oscillator for calibration purposes, a loudspeaker or headphone jack for aural monitoring and a built-in battery charger.

A compact metal cabinet 8 inches high, 12 inches wide and 9 inches deep is used to house the instrument. The weight of the instrument with battery is 14 pounds. The front panel contains all of the operating controls and is protected from damage by a removable metal cover. The PULL ON control switch will be placed in the OFF position when the cover is installed, thereby preventing the possibility of battery discharge while the instrument is not in use.

The major portion of Voltmeter circuitry is laid out on printed circuit boards and assembled into five separate modules. Extensive shielding is provided for modules and components to prevent interaction between circuits.

The Voltmeter is powered by a rechargeable nickel-cadmium battery for up to 35 hours of operation without charging. A polar three-pin male connector mounted to front panel provides access for battery charging from 115 VAC. The Voltmeter may be operated while charging.

Table 1 3121A SPECIFICATIONS

FREQUENCY RANGE	1 KHz to 1500 KHz (3 bands) Band A 1 KHz to 310 KHz Band B 300 KHz to 700 KHz Band C 700 KHz to 1500 KHz
INPUT IMPEDANCES	75Ω, 135Ω, 600Ω (unbalanced) Bridging (unbalanced) Nominal 5K
INPUT LEVEL	7.75uv to 10V -100 dbm to +22 dbm
SELECTIVITY	250 Hz ± 25 Hz at 3 db down 1100 Hz Maximum at 60 db down 2500 Hz Nominal at 3 db down 10,000 Hz Maximum at 60 db down
FREQUENCY ACCURACY	Band A ± 1 KHz Band B ± 2 KHz Band C ± 3 KHz
MEASUREMENT ACCURACY	± 1db
SPURIOUS RESPONSE AND INTERMODULATION PRODUCTS	Greater than 55 db down
INTERNAL CALIBRATION SOURCE	250 KHz Crystal Oscillator
TYPES OF DEMODULATION	AM, LSB and USB
TEMPERATURE RANGE	-10 to + 50°C
POWER SUPPLY	12 volt nickel-cadmium battery rechargeable from 115 VAC
CURRENT DRAIN	35 MA average
BATTERY LIFE	35 hours without recharging
OVERALL DIMENSIONS	8" h x 12" w x 9" d
WEIGHT	14 pounds

Table 2 OPERATING CONTROLS

Panel Marking	Description	Function
BAND SELECTOR	3 position rotary switch	(1) sets frequency of band to be tuned. (A) 1 KHz to 300 KHz (B) 300 KHz to 700 KHz (C) 700 KHz to 1500 KHz
TUNING	Driven tuning mechanism, 2 speed	Tunes Voltmeter to frequency indicated on dial face
SELECTIVITY	2 position rotary switch	Sets bandwidth 250 Hz or 2.5 KHz
ATTENUATOR	11 position rotary switch	Serves as level range control by controlling Voltmeter sensitivity in 10 DB steps up to 100 DB
INPUT SELECTOR	5 position rotary switch	(1) 600Ω, 135Ω, 75Ω positions connect Voltmeter input circuits to input jacks for terminated inputs. (2) BRIDGE position connects Voltmeter input circuits to input jacks for bridging measurement. (3) CAL switches input circuit for calibration.
CAL LEVEL	Potentiometer	Adjust overall Voltmeter gain when calibrating
MONITOR	3 position rotary switch	Switch for AM and single sideband (LSB, USB) demodulation
AUDIO LEVEL & PULL ON	Potentiometer & switch	(1) Adjust AUDIO LEVEL for speaker or headset level. (2) PULL ON provides connection of battery power to unit.
HEADSET	Headphone jack	Provision for audio monitoring
115 VAC	Cord and connector, polarized	115 volt cord and connector for charging circuit & AC operation
INPUT	Binding posts	Input connectors for line measurements.

CHAPTER II

3121A OPERATION

1. PREPARATION.

The Voltmeter has been thoroughly inspected at the factory and is covered by Warranty. Prior to use, the instrument should be inspected, for in-transit damage.

If damage has occurred it should be reported to the carrier and to RYCOM INSTRUMENTS INC.

The Voltmeter is shipped ready for use with battery installed.

2. BATTERY.

The battery will provide up to 35 hours of operation between charges. A completely discharged battery will recharge in eighteen hours or less. Continuous charging is permissible without damage to the battery. It is recommended that a routine recharging schedule be established depending on unit use. The battery should be charged at least once per month.

The following check tests the condition of the battery while battery is delivering full load current.

a. Full AUDIO LEVEL control to switch power on. Press BATTERY TEST switch.

b. Observe meter. Battery is charged when the meter indicates 0 DB ±. 5 DB. If the indication is below -. 5 DB recharge battery.

3. OPERATIONAL CALIBRATION.

This procedure calibrates the Voltmeter level and checks the main tuning dial.

a. To calibrate the Voltmeter for voltage and DBM (600Ω) proceed as follows:

1. Set INPUT SELECTOR switch to CAL position.
2. Set ATTENUATOR switch to -30 DB CAL position.
3. Set SELECTIVITY to ~~250~~ 100 Hz.
4. Set BAND SELECTOR to band A.
5. Rotate TUNING dial control to 250 KHz.
6. Adjust TUNING control for maximum indication on the meter.

7. Adjust CAL LEVEL control for 0 DB indication on meter. The Voltmeter is now calibrated to indicate voltage and DBM (600Ω).

b. To calibrate for DBM (135Ω), repeat steps 1 thru 7 (page 4 and 5) except step 2 & 7. For step 2 set ATTENUATOR to -20 DB and in step 7 adjust CAL LEVEL for -3.5 DB meter indication.

c. To calibrate for DBM (75Ω), repeat steps 1 thru 7 (page 4 and 5) except step 2 & 7. For step 2 set ATTENUATOR to -20 DB and in step 7 adjust CAL LEVEL for -1.0 DB meter indication.

d. Below is a reference chart for calibration of unit.

SOURCE IMPEDANCE	ATTENUATOR	METER INDICATION
600Ω	CAL -30	0 DB
135Ω	-20	-3.5 DB (red)
75Ω	-20	-1.0 DB (red)

e. A frequency check may be made by tuning dial throughout its range. An indication will be noted at every 250 KHz point (i.e., 500, 750, 1000, 1250 and 1500 KHz).

4. CORRELATION CHART: TERMINATION, CALIBRATION, IMPEDANCE METER INDICATION.

INPUT SELECTOR	CALIBRATION IMPEDANCE	METER INDICATION
BRIDGE	600Ω	Volts & DBM (600Ω)
	135Ω	DBM (135Ω)
	75Ω	DBM (75Ω)
600Ω TERM	600Ω	Volts & DBM (600Ω)
	135Ω	DBM (135Ω)
	75Ω	DBM (75Ω)
135Ω TERM	135Ω	DBM (135Ω)
	75Ω	DBM (75Ω)
	600Ω	Volts & DBM (600Ω)
75Ω TERM	75Ω	DBM (75Ω)
	600Ω	Volts & DBM (600Ω)
	135Ω	DBM (135Ω)

5. LINE MEASUREMENTS - INPUT JACKS.

To perform line measurements proceed as follows:

a. Connect Voltmeter INPUT to circuit being tested.

b. Calibrate Voltmeter per paragraph 3.

c. Set INPUT SELECTOR switch to desired impedance setting.

d. Rotate TUNING control and switch BAND SELECTOR to frequency of signal being measured.

e. Rotate ATTENUATOR selector switch until meter indication is in upper 2/3 of scale.

f. Adjust TUNING control for maximum indication on meter.

g. Read meter indication. See Correlation Chart, paragraph 4. To obtain input signal level, algebraically add the meter indication to the ATTENUATOR setting.

6. LINE MEASUREMENTS - BALANCED.

To make balanced line measurements follow steps a. or b. below:

a. Place the Voltmeter face up (resting on four rubber feet) and remove the AC line cord from the 115 VAC receptacle. This places approximately 100uuf of unbalance to ground from the ground terminal of the Voltmeter.

b. A balancing transformer, RYCOM Model 3061, can be used. This transformer is optional and can be obtained from RYCOM. See instructions on transformer for use.

Proceed with measurements as described in paragraph 4, Line Measurements - Input Jacks.

7. MONITORING.

Provision is made to monitor audio signals that may be present on line signals under measurement. To monitor signals, switch SELECTIVITY to 2.5 KHz, set MONITOR switch in desired position (AM, LSB or USB) and adjust AUDIO LEVEL control.

CHAPTER III

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1. GENERAL.

The Voltmeter employs a single conversion superheterodyne circuit to measure frequencies in the range of 1 KHz to 1.5 MHz with a bandpass of 250 Hz or 2.5 KHz. Figure 12 illustrates a functional block diagram of the Voltmeter. Figure 13 shows a schematic diagram of the Voltmeter.

At the input of the Voltmeter, a switch is used to select the input signal from either the 250 KHz calibrate oscillator or from the front panel input connectors. A filter and matching network is incorporated in the input circuits to attenuate unwanted high frequency components and to provide proper input impedances.

To control the sensitivity of the Voltmeter, a variable attenuator provides up to 100 DB of attenuation in 10 DB steps. Tuning of the Voltmeter is accomplished by a variable oscillator (local oscillator) that operates over the frequency range of 2216 KHz to 3715 KHz. Both the input signal and the local oscillator signal are applied to a mixer stage where the heterodyning action takes place to produce a 2215 KHz difference frequency. The IF amplifier is tuned to 2215 KHz and amplifies the output of the mixer.

The 250 Hz and 2.5 KHz bandpass of the Voltmeter is determined by crystal filters located between the 1st and 2nd IF amplifiers. After amplification by the IF amplifier, the signal is rectified and filtered in a meter detector circuit and then applied to a meter.

The second detector when used with insertion frequency of 2213.5 KHz and 2216.5 KHz will produce single sideband demodulation for audio monitoring.

The calibrate oscillator generates a 250 KHz square wave and is regulated for amplitude level to provide an output level that is equivalent to -30 DBM at the input connectors. Before voltage measurements are made, the Voltmeter sensitivity is calibrated by connecting the calibrate oscillator output to the Voltmeter input circuits and adjusting the IF amplifier gain for 0 DBM indication.

When the Voltmeter is used for power measurements, the variable attenuator is used to change the Voltmeter sensitivity in calibrated steps of 10 DB. For example, assume that a signal level of -42 DBM is applied to the input of the calibrated Voltmeter. Adjusting the attenuator to the -40 DB position will result in an indication of -2 DB. The input level is determined by algebraically adding the meter indication to the attenuator setting: -40 DE -2DB = -42 DBM.

2. INPUT MODULE A1.

The input circuits are composed of an INPUT SELECTOR switch S1, and a 100 DB ATTENUATOR switch S2. Input signals are applied to the input binding posts E1 and E2.

Resistors R1, R2 or R3 are switched by S1 to provide termination for 75 ohm, 135 ohm or 600 ohm lines.

3. EMITTER FOLLOWER AND CALIBRATE OSCILLATOR MODULE A2.

The function of the bootstrapped emitter follower is to match the attenuator S2 to the lowpass filter FL3.

The calibrate oscillator is 250 KHz crystal controlled, biased so the output voltage swings between the regulated power supply voltage and ground. The output is applied through a CAL OSC ADJ potentiometer R12 to switch S1 for calibrating the Voltmeter level and to check the dial frequency accuracy.

4. LOWPASS FILTER FL3.

The lowpass filter has a cutoff frequency of 1.76 MHz and provides 60 DB of attenuation at 2215 KHz. The input and output impedances are 150 ohms.

5. OSCILLATOR- MODULATOR MODULE A3

The input signal is heterodyned with the local oscillator injection in balanced modulator diodes CR1. The modulator diodes operate as a balanced shunt modulator and short the signal to ground during half the local oscillator cycle. The 2215 KHz output of the modulator is capacitive coupled to the base of the first IF amplifier A4Q1.

The modulator driver (Q1) output is transformer (T1) coupled to the modulator diodes. The local oscillator level at the junction of the modulator diodes is very small due to the matching of components. The input to the modulator driver is capacitive coupled from the emitter of the local oscillator Q2.

The local oscillator is a Colpitts type with three switched frequency bands. The frequency on each band is varied by tuning C1, an 11-150 uuf air variable capacitor. The oscillator circuit is temperature stabilized by C8.

6. IF AMPLIFIER MODULE A4.

The 2215 KHz output of the modulator is capacitive coupled to the first IF amplifier. The amplifier and filter driver consists of three stages, Q1, Q2 and Q3 and has 36 DB gain. Q1 and Q2 is a Darlington connected amplifier. The output is transformer coupled to Q3, the filter driver amplifier.

The Voltmeter contains two crystal filters which are selected by switch S4. The center frequency of both filters is 2215 KHz and the bandwidths are 250 Hz (FL1) and 2.5 KHz (FL2) at 3 DB down. Trimmer capacitors C7 through C10 tune the filters for maximum flatness. Each filter has an input impedance of 4000 ohms and an output impedance of 1000 ohms.

The filter matching amplifier and second IF amplifier consists of three stages, Q4, Q5 and Q6. The output of the crystal filter is capacitively coupled to the filter matching amplifier consisting of Q4 and Q5. The bias current of Q5 if adjusted by R2 (CAL LEVEL). Changing the bias current controls the gain of the stage. The output of Q5 drives the common emitter amplifier Q6. The second IF amplifier Q6 has a gain of 20 DB to 40 DB depending upon the setting of R2.

The third IF amplifier Q7 provides 30 DB of gain and is transformer coupled to the IF output amplifier Q8. The output is also capacitive coupled to the meter detector circuit.

The meter detector diode CR1 is a peak envelope type detector. The output is applied through R27 to S6 which is connected to the meter.

The IF output amplifier Q8 provides isolation of the carrier reinsertion oscillator signal and also drives the demodulator diodes CR2 and CR3.

7. DEMODULATOR MODULE A5.

The AM demodulator is a shunt type using CR3 as the diode. S5 connects the anode end to ground when in AM position. R24 and C10 provide RF filtering. The audio signal is capacitive coupled from R1 (AUDIO LEVEL) to the base of Q5, the first audio amplifier.

The sideband demodulator consists of CR2 and CR3 which are supplied with carrier signal from Q4. These diodes operate as a balanced shunt demodulator and shorts the IF signal to ground during half the injection signal cycle. This produces an audio difference signal which is coupled to the base of the first audio amplifier Q5.

The carrier reinsertion oscillator Q3 is crystal controlled by Y1 or Y2. The output is capacitive coupled to balanced phase splitter Q4, which supplies out-of-phase signals to the demodulator diodes CR2 and CR3. MONITOR switch S5 applies power to Q3 and Q4, and selects the crystal for LSB or USB demodulation.

8. AUDIO AMPLIFIER, MODULE A5.

The audio amplifier is composed of the 1st audio amplifier Q5 and the audio output amplifier IC1. The output of the demodulator is fed thru the RF decoupling network R15 and C10 to the AUDIO LEVEL control. The AUDIO LEVEL control arm drives the 1st audio amplifier Q5. The audio output amplifier IC1 is an intergrated circuit. The gain of the audio output amplifier is approximately 28 db.

9. REGULATOR AND CHARGER, MODULE A5.

The regulator is a series type, with Q1 as the series regulator transistor, and Q2 as the control amplifier. VR1, a 9.1 volt reference diode, controls the bias on Q2. The output is also connected through resistor R4 to the BATTERY TEST switch for checking battery condition. A meter reading of 0 DB ±.5 DB indicates the battery charge is adequate for regulator operation.

The battery BT1 charging circuit consist of CR1, C2 and R3 on the module and power transformer T1 which is mounted on the chassis. The charging circuit is activated anytime the unit is connected to a 115 VAC 60 cycle source through the power cable supplied.

CHAPTER IV

MAINTENANCE

1. INTRODUCTION.

This equipment will give comparatively trouble free performance provided normal operating procedures are observed. In the event of any malfunction, first check the battery by turning the unit ON, press the BATTERY TEST button and observe the meter for a 0DB ±.5 DB reading.

Before attempting to trouble shoot the Voltmeter, Chapter III "Theory of Operation" should be studied. The trouble shooting procedure consists of three parts:

Isolation to a particular module
Module trouble shooting
Transistor voltage check

2. TEST EQUIPMENT.

The following test equipment is required to test and align the Voltmeter and is not supplied.

a. Sweep Generator and Display Unit. Use to align IF amplifier and crystal filters.

1. Center frequency between 50 KHz and 500 KHz.

2. Sweep width variable from 5 KHz to 40 KHz.

3. Sweep rate 1 to 4 per second.

b. VTVM. (Triplett 850 or equivalent).

c. Counter.

1. Minimum counting rate 3000 KHz.

2. Gate time 1 second and .01 second.

3. Display time variable.

d. Signal Generator. (Hewlett Packard 651 or equivalent).

e. AC-VTVM. (Ballantine 303 or equivalent).

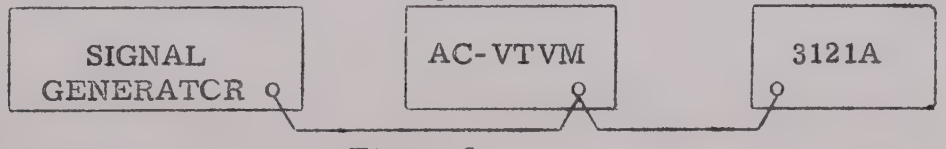


Figure 2
TEST SET UP FOR MODULE ISOLATION

3. TROUBLESHOOTING.

Before proceeding with step 1 in Table 3, connect Voltmeter in the test setup shown in Figure 2 and perform the following steps.

a. Set the Selective Voltmeter as follows.

1. INPUT SELECTOR to BRIDGE.
2. BAND SELECTOR to band A.
3. TUNING to 250 KHz.
4. ATTENUATOR to -60 DB.
5. CAL LEVEL fully clockwise.
6. SELECTIVITY to 2.5 KHz.

b. Adjust signal generator to 0.78V, 250 KHz signal output.

Table 3 MODULE ISOLATION

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Turn unit on. Press BATTERY TEST switch.	Meter reads 0 DB ±.5 DB.	Battery needs recharge or power supply regulator is defective on Module A5. See Table 4.
2	Set INPUT SELECTOR to BRIDGE. Connect AC-VTVM to pin 7 on Module A2.	AC-VTVM indicates 77 millivolts.	Trouble is in input Module A1. See Table 5.
3	Set INPUT SELECTOR to CAL. Connect AC-VTVM to pin 7 on Module A2.	AC-VTVM indicates 2.5 millivolts.	Trouble is in calibrate oscillator on Module A2. See Table 7.
4	Set INPUT SELECTOR to BRIDGE. Connect AC-VTVM to pin 1 on Module A2.	AC-VTVM indicates 34 millivolts.	Trouble is in Emitter follower on Module A2. See Table 6.
5	Connect AC-VTVM to pin E2 on Module A4.	AC-VTVM indicates 30 millivolts.	Trouble is in FL3 lowpass filter. See Table 8.
6	Set BAND SELECTOR to band A. Tune dial to zero frequency.	Selective Voltmeter meter reads past full scale.	Trouble is in Module A3. See Table 9.
7	Tune dial to 250 KHz and obtain 0 db meter reading. Set ATTENUATOR to +10 DBM. Connect AC-VTVM to E6 on Module A4.	AC-VTVM indicates .15 volts.	Trouble is in Module A4. See Table 10.
8	Connect AC-VTVM to E10 Module A5. Set monitor switch to LSB. Audio level to 2/3 CW.	AC-VTVM indicates .14 volts.	Trouble is in side-band oscillator Module A5. See Table 11.
9	Connect AC-VTVM to E12 on Module A5.	AC-VTVM indicates approximately 4 volts.	Trouble is in audio amplifier Module A5. See Table 12.

Table 4 REGULATOR AND CHARGING CIRCUIT MODULE A5

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Connect VTVM to E4 on Module A5.	VTVM indicates 11.5 to 13.5 volts DC.	Check battery connections. Battery needs recharging.
2	Connect VTVM to E1 on Module A5. Full AUDIO LEVEL switch on.	VTVM indicates 11.5 to 13.5 volts DC.	Check switch S7 and connections.
3	Connect VTVM to E7 on Module A5. Full AUDIO LEVEL switch on.	VTVM indicates 9.1 volts DC.	Check Q1 and Q2 voltages. See Table 13.

Table 5 INPUT MODULE A1

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Set INPUT SELECTOR to BRIDGE. Connect AC-VTVM to pin 3 of S1. Set ATTENUATOR to -80 DB.	AC-VTVM indicates .78 volts.	Check C1 and switch S1 connections for continuity.
2	Set INPUT SELECTOR to BRIDGE. Connect AC-VTVM to pin 7 on Module A2. Set ATTENUATOR to -80 DB.	AC-VTVM indicates .78 volts.	Check S2 and resistors R7 thru R19.

Table 6 EMITTER FOLLOWER MODULE A2

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Set signal generator to 250 KHz at -30 DB and connect to pin 7 of Module A2. Connect AC-VTVM to Pin 1.	AC-VTVM indicates 11 millivolts.	Check Q1 voltages. See Table 13.

Table 7 CALIBRATE OSCILLATOR MODULE A2

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Set INPUT SELECTOR to CAL. Connect AC-VTVM to pin 4 on Module A2.	AC-VTVM reads 26 millivolts.	Check Q2 voltages. See Table 13.

Table 8 LOWPASS FILTER FL3

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Set signal generator to 250 KHz at 24.5 MV and connect to IN on FL3. Connect AC-VTVM to pin OUT on FL3.	AC-VTVM reads 22 millivolts.	Check continuity of FL3.
2	Connect ohmeter from pin IN to OUT.	Ohmeter reads 2Ω.	Trouble is in FL3.

Table 9 LOCAL OSCILLATOR MODULE A3

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Turn unit on. Connect AC-VTVM to junction of R1 and CR1.	AC-VTVM reads .55 volts.	Check Q1, Q2 voltages. See Table 13.
2	Connect AC-VTVM to junction of R5 and R6.	AC-VTVM reads between .15 and .3 volts.	Check Q2 voltages. See Table 13.

Table 10 IF AMPLIFIER MODULE A4

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Set signal generator to 2215 KHz at -100 DB (7.75 uV) and connect to E2 on Module A4. CAL LEVEL full CW. Set SELECTIVITY to 2.5 KHz.	Selective Voltmeter reads -6 DBM.	Adjust T1, T2, and T3 for maximum reading on meter. Check Q1 thru Q8 voltages. See Table 13.

Table 11 REINSERTION OSCILLATOR MODULE A5

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Turn MONITOR to LSB. Connect AC-VTVM to base of Q4.	AC-VTVM reads .75 volts.	Check Q3 voltages. See Table 13. Check crystals.
2	Connect AC-VTVM to junction of C8 and R13.	AC-VTVM reads 0.5 volts.	Check Q4 voltages. See Table 13.

Table 12 AUDIO AMPLIFIER MODULE A5

Step	Procedure	Normal Indication	If Indication is Abnormal
1	Set signal generator to 1 KHz at 20 millivolts and connect to E10 on Module A5. Turn R1 AUDIO LEVEL maximum CW. Connect AC-VTVM to collector of Q5.	AC-VTVM reads 150 millivolts.	Check Q5 voltages. See Table 13.
2	Connect AC-VTVM to E12 on Module A5.	AC-VTVM reads 4 volts.	Check IC1 voltages. See Table 13.

Table 13 Transistor Voltage Chart

Module	Transistor	Emitter	Base	Collector
A2	Q1	3.7	4.4	9.55
	Q2	2.3	2.1	6.0
A3	Q1	1.85	2.3	6.8
	Q2	1.6	2.0	8.0
A4	Q1	3.3	3.9	9.5
	Q2	2.6	3.3	9.5
	Q3	1.35	2.0	4.6
	Q4	1.9	2.5	3.6△
				9.0△△
	Q5	1.2	1.9	3.6
	Q6	2.2	2.8	8.9
	Q7	.9	1.5	8.8
	Q8	1.5	2.2	5.0
A5	Q1	9.5	10.3	12
	Q2	0	.65	10.3
	Q3	1.3	1.5	3.5
	Q4	1.7	2.0	7.8
	Q5	.4	1.0	5.0

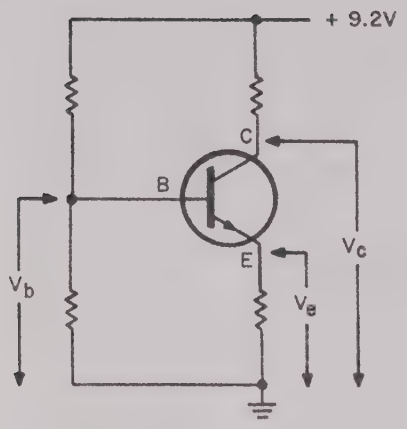
Intergrated Circuit	Pin 3	Pin 7	Pin 12	Pin 14
A5IC1	7.0	6.0	1.3	1.3

Set Selective Voltmeter controls as follows:

1. No signal input.
2. CAL LEVEL fully CW.
3. MONITOR - LSB.
4. INPUT SELECTOR - CAL.

Transistor and intergrated circuit information on following page. Readings taken with VTVM and should be ±10%. All voltages positive with respect to chassis ground.

△A4Q4 for Ser. 630 and below
△△A4Q4 for Ser. 631 and above

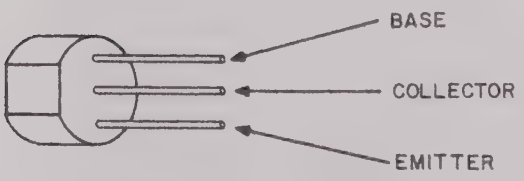


WHERE B = BASE, C = COLLECTOR, E = EMITTER and V_b = BASE VOLTAGE, V_c = COLLECTOR VOLTAGE, V_e = EMITTER VOLTAGE

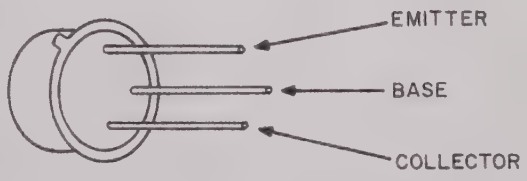
1. IF V_e IS LESS THAN VALUE SHOWN IN TABLE 13, AND V_b IS NORMAL, TRANSISTOR IS OPEN.
2. IF V_e IS GREATER THAN INDICATED, TRANSISTOR IS SHORTED.
3. THE NORMAL VOLTAGE BETWEEN BASE AND EMITTER OF AN AMPLIFIER WITH SILICON TRANSISTORS IS BETWEEN 0.5 AND 0.7 VOLTS.

Figure 3. Typical Transistor Trouble Shooting Schematic

Typical transistor trouble shooting. Figure 3 presents typical trouble shooting for a N-P-N common emitter amplifier stage. Before replacing transistor, check associated circuit components. See Table 13 for typical transistor voltages.

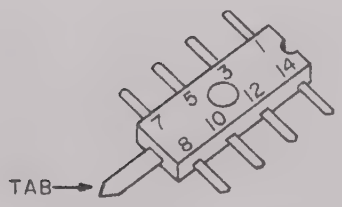


RC3710 TYPE



2N3053 TYPE

Figure 4. Transistor Lead Configuration



PA237 TYPE

Figure 5. Intergrated Circuit Lead Configuration

4. ALIGNMENT.

a. Calibrate Oscillator. In the event of parts replacement or normal aging of parts, it may be necessary to calibrate the Voltmeter. This is accomplished by comparing the calibrat e oscillator output level to a known external source. The equipment should be connected as shown in Figure 6 before proceeding with step 1 through 8.

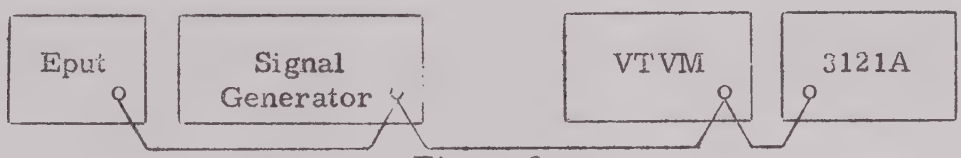


Figure 6
Test Set Up For Level Calibration

1. Adjust Selective Voltmeter controls as follows:

   a. INPUT SELECTOR to BRIDGE.
   b. SELECTIVITY to 250 Hz.
   c. ATTENUATOR to -30 DB CAL.
   d. BAND SELECTOR to band A.
   e. TUNING to 250 KHz CAL.

2. Adjust signal generator frequency to 250 KHz.
3. Adjust signal generator output to -30 DB (24.5 mv) level.
4. Adjust TUNING control for maximum reading on meter.
5. Adjust CAL LEVEL for 0 DBM reading on meter.
6. Set INPUT SELECTOR to CAL position.
7. Adjust TUNING control for maximum reading on meter.
8. Adjust CAL OSC ADJ R12 on Module A2 for 0 DBM reading on meter. The Voltmeter is now calibrated and ready for operation.

b. IF Amplifier. The alignment of the 2215 KHz IF amplifier, module A4, is performed by using the internal calibrate oscillator as a signal source. Proceed as follows:

1. Set Selective Voltmeter controls as follows:

   a. INPUT SELECTOR to CAL.
   b. ATTENUATOR to -30 DB CAL.
   c. SELECTIVITY to 250 Hz.
   d. BAND SELECTOR to band A.
   e. TUNING to 250 KHz CAL for maximum Voltmeter reading.

2. Adjust CAL LEVEL so meter reads in upper half of scale.
3. Adjust T1. T2 and T3 with a non-metallic tuning tool for maximum meter reading.

c. Crystal Filters FL1 and FL2. Crystal filters FL1 and FL2 on module A4 can be adjusted for passband flatness by using the internal calibrate oscillator. Proceed as follows:

1. Set Selective Voltmeter controls as follows:

   a. INPUT SELECTOR to CAL.
   b. ATTENUATOR to -30 DB CAL.
   c. BAND SELECTOR to band A.
   d. TUNING to 250 KHz CAL.
   e. SELECTIVITY to 2.5 KHz.

2. Adjust TUNING so that meter reads in valley of passband ripple.
3. Adjust C9 and C10 for maximum meter reading.
4. Repeat steps 2 and 3 until filter FL2 passband ripple is within ±.5 DB.
5. Set SELECTIVITY to 250 Hz.
6. Adjust TUNING so that meter reads in valley of passband ripple.
7. Adjust C7 and C8 for maximum meter reading.
8. Repeat steps 6 and 7 until filter FL1 passband ripple is within ±.5 DB.

d. Local Oscillator. Alignment of the frequency dial is performed by connecting the equipment as shown in Figure 7.

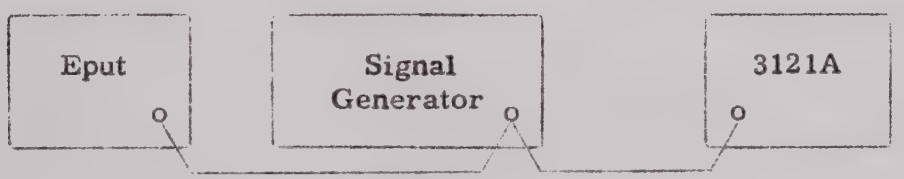


Figure 7
Test Set Up For Frequency Alignment.

1. Set equipment controls as follows:

   a. Signal generator to 0 DB level out.
   b. INPUT SELECTOR to BRIDGE.
   c. ATTENUATOR to 0 DB.
   d. SELECTIVITY to 250 Hz.

2. Band A alignment.

   a. BAND SELECTOR to band A.
   b. SIGNAL generator to 50 KHz.
   c. TUNING to 50 KHz.
   d. Adjust L3 for maximum meter reading.
   e. Signal generator to 250 KHz.
   f. TUNING to 250 KHz.
   g. Adjust C14 for maximum meter reading.
   h. Repeat steps 2b through 2g until dial tracks within ±1 KHz on band A.

3. Band B alignment.

   a. BAND SELECTOR to band B.
   b. Signal generator to 350 KHz.
   c. TUNING to 350 KHz.
   d. Adjust C16 for maximum meter reading.
   e. Signal generator to 650 KHz.
   f. TUNING to 650 KHz.
   g. Adjust C12 for maximum meter reading.
   h. Repeat steps 3b through 3g until dial tracks within 2 KHz on band B.

4. Band C alignment.

   a. BAND SELECTOR to band C.
   b. Signal Generator to 1400 KHz.
   c. TUNING to 1400 KHz.
   d. Adjust C10 for maximum meter reading.

5. PARTS LIST.

When ordering parts, always include:

1. Name, Model and Serial Number of the Instrument.
2. Module and circuit symbol.
3. Part number.
4. Description.

Order parts from:

RYCOM INSTRUMENTS
9351 East 59th Street
Raytown, Missouri 64133

Telephone 816-353-2100

Note: $10.00 minimum on all orders.

LIST OF MANUFACTURERS

Symbol is listed in parts list under manufacturer.

Symbol	
A	Allen Bradley Company
B	Belden Mfg. Company
C	C. T. S. Corporation
D	Continental Device Corporation
E	Dale Electronics, Souix Division
F	E. F. Johnson Company
G	Electra Mfg. Company
H	Electro Cube Inc.
I	Electro Motive Mfg. Co. Inc.
J	Electron Products Co.
K	Electronic Research Corp.
L	Erie Technological Products Inc.
M	Fairchild Semiconductor
N	General Electric
O	General Instruments
P	General Radio
Q	Gould National Battery Co.
R	Hammarlund Mfg. Company
S	Mec Incorporated
T	Oaktron Industries Inc.
U	RYCOM INSTRUMENTS INC.
V	Semincon Inc.
W	Spectran Electronics Corp.
X	Switchcraft Inc.
Y	Sylvania Electric Prod. Inc.
Z	Texas Instruments Inc.
AA	Tower Mfg. Corp.
AB	Western Electric Co.
AC	Wilco Corp.
AD	Aladdin Electronics
AE	Callins Industries Inc.
AF	Sprague Electric Co.
AG	Good-All Electric Mfg. Co.
AH	Corning Electronic Components
AI	RCA
AJ	Grayhill
AK	J. W. Miller Co.
AL	Union Carbide Corp.

*Previously accounted for.

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A1			
C1	Cap. 5.0uf ±10% 200 WVDC mylar	X663F50502W	AG	1
C2	Cap. 0.1uf -20, +80 % 25 WVDC disc ceramic	5815Y5U104Z	L	16
E1	Binding Post, Red	29-1-R	AJ	1
E2	Binding Post, Black	29-1-B	AJ	1
R1	Res. 75Ω 2W±5% Metal Film	Type C-42S	AH	1
R2	Res. 140Ω ½W ±1% Metal Film	RY65D1400F	U	1
R3	Res. 681Ω ½W ±1% Metal Film	RY65D6810F	U	1
R4	Not Used			
R5	Not Used			
R6	Not Used			
R7	Res. 6040Ω 1/8W ±1% Metal Film	RY57D6041F	U	1
R8	Res. 3400Ω 1/8W ±1% Metal Film	RY57D3401F	U	1
R9	Res. 1620Ω 1/8W ±1% Metal Film	RY57D1621F	U	1
R10	Res. 4530Ω 1/8W ±1% Metal Film	RY57D4531F	U	1
R11	Res. 499Ω 1/8W ±1% Metal Film	RY57D4990F	U	1
R12	Res. 4990Ω 1/8W ±1% Metal Film	RY57D4991F	U	3
R13	Res. 4870Ω 1/8W ±1% Metal Film	RY57D4871F	U	1
R14	Res. 158Ω 1/8W ±1% Metal Film	RY57D1580F	U	1
R15	Res. 4990Ω same as R12			
R16	Res. 49.9Ω 1/8W ±1% Metal Film	RY57D49R9F	U	1
R17	Res. 4990Ω same as R12			
R18	Res. 15.8Ω 1/8W ±1% Metal Film	RY57D15R8F	U	2
R19	Res. 15.8Ω same as R18			
S1	Switch, Rotary	3121S1A	U	1
S2	Switch, Rotary	3121S2	U	1

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A2			
C1	Cap, 0.1uf ±10% 200 WVDC metalized mylar	210B1C104K	H	11
C2	Cap, 0.01uf ±20% 200 WVDC disc ceramic	3805030Z5U00103M	L	15
C3	Cap, 470uuf ±5% 500 WVDC silver mica	DM19E471J	I	1
C4	Cap, 10uf -10+100% 15WVDC dry electrolytic	30D106G015BA2	AF	4
C5	Cap, 0.1uf same as C1			
C6	Cap, 0.1uf -20 +80% 25WVDC disc Ceramic	5815Y5U104Z	L	*
C7	Cap, 10uf, same as C4			
C8	Cap, 250uuf ±5% 500 WVDC silver mica	DM15E251J	I	1
C9	Cap, 0.1uf, same as C1			
L1	Coil, RF 1.0mh	U102	AC	7
Q1	Semiconductor Device, Transistor NPN	RC3710	U	17
Q2	Semiconductor Device, Transistor, same as Q1			
R1	Res. 10K ½W ±5% carbon	RC20GF103J	A	13
R2	Res. 10K, same as R1			
R3	Res. 680Ω ½W ±5% carbon	RC20GF681J	A	5
R4	Res. 33K ½W ±5% carbon	RC20GF333J	A	2
R5	Res. 2700Ω ½W ±5% carbon	RC20GF272J	A	4
R6	Res. 68Ω ½W ±5% carbon	RC20GF680J	A	4
R7	Res. 3300Ω ½W ±5% carbon	RC20GF332J	A	3
R8	Res. 2200Ω ½W ±5% carbon	RC20GF222J	A	3
R9	Res. 150Ω ½W ±5% carbon	RC20GF151J	A	1
R10	Res. 33K, same as R4			
R11	Res. 10K, same as R1			
R12	Res. Variable 500Ω 1/8W ±20%	220S501B	C	1
Y1	Crystal 250.0000 KHz	TYPE CR-46A/U	K	1

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A3			
C1	Cap. 0.1uf -20 +80% 25 WVDC disc ceramic	5815Y5U104Z	L	*
C2	Cap. 0.1uf ±10% 200 WVDC metalized mylar	210B1C104K	H	*
C3	Cap. 0.1uf, same as C2			
C4	Cap. 0.01uf ±20% 200 WVDC disc ceramic	0805030Z5U00103M	L	*
C5	Cap. 0.1uf, same as C2			
C6	Cap. 1500uuf ±5% 500 WVDC silver mica	DM19E152J	I	1
C7	Cap. 4000uuf ±5% 500 WVDC silver mica	DM19E402J	I	1
C8	Cap. 47uuf ±5% 200 WVDC N470 disc ceramic	0805000T2H0470J	L	1
C9	Cap. 27uuf ±5% 500 WVDC NPO disc ceramic	0851000C0G0270J	L	1
C10	Cap. variable 1.7-20uuf air dielectric	193-6-5	F	2
C11	Cap. 110uuf ±5% 500 WVDC NPO disc ceramic	0841000C0G0111J	L	1
C12	Cap. 1.7-20uuf, same as C10			
C13	Cap. 155uuf ±5% 200 WVDC N080 Disc ceramic	0845030U1G01550J	L	1
C14	Cap. variable 2.2-34uuf air dielectric	193-10-5	F	2
C15	Cap. 535uuf ±1% 500 WVDC silver mica	DM19E5350F	I	1
C16	Cap. 2.2-34uuf, same as C14			
C17	Cap. 33uuf ±5% 200 WVDC NPO disc ceramic	0805000C0G0330J	L	1
C18	Cap. 0.01uf, same as C4			
CR1	Semiconductor Device, Diode	RY3605	U	1
L1	Coil, RF 1.0mh	U102	AC	*
L2	Coil, RF 150uh	3150-12	AC	2
L3	Coil, RF Var. 1.5-3.1uh	3121L3A	U	1
L4	Coil, RF 150uh, same as L2			
Q1	Semiconductor Device, Transistor, NPN	RC3710	U	*
Q2	Semiconductor Device, Transistor, Same as Q1			
R1	Res. 68Ω ½W ±5% carbon	RC20GF680J	A	*
R2	Res. 68Ω, same as R1			
R3	Res. 680Ω ½W ±5% carbon	RC20GF681J	A	*
R4	Res. 1000Ω ½W ±5% carbon	RC20GF102J	A	10

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A3 (continued)			
R5	Res. 3300Ω ½W ±5% carbon	RC20GF332J	A	*
R6	Res. 10K ½W ±5% carbon	RC20GF103J	A	*
R7	Res. 10K, same as R6			
R8	Res. 2700Ω ½W ±5% carbon	RC20GF272J	A	*
R9	Res. 1000Ω, same as R4			
R10	Res. 1000Ω, same as R4			
R11	Res. 47Ω ½W ±5% carbon	RC20GF470J	A	1
S3	Switch, Rotary	3121S3A	U	1
T1	Transformer, Balanced Demodulator	58-122-02	AD	1

PARTS LIST

Sym	Description	Parts No.	Mfr	Tot Qty
	Module A4			
C1	Cap. 0.01uf ± 20% 200 WVDC disc ceramic	0805030Z5U00103M	L	*
C2	Cap. 0.1uf -20 +80% 25 WVDC disc ceramic	5815Y5U104Z	L	*
C3	Cap. 0.1uf ±10% 200 WVDC metalized mylar	210B1C104K	H	*
C4	Cap. 0.1uf, same as C2			
C5	Cap. 0.1uf, same as C2			
C6	Cap. 0.01uf, same as C1			
C7	Cap. Var. 5-25uuf 350 WVDC NPO ceramic	0557051C0P039R	L	4
C8	Cap. Var. 5-25uuf, same as C7			
C9	Cap. Var. 5-25uuf, same as C7			
C10	Cap. Var. 5-25uuf, same as C7			
C11	Cap. 68uuf ±5% 500 WVDC silver mica	DM15E680J	I	1
C12	Cap. 0.01uf, same as C1			
C13	Cap. 0.1uf, same as C3			
C14	Cap. 0.1uf, same as C2			
C15	Cap. 0.1uf, same as C2			
C16	Cap. 0.01uf, same as C1			
C17	Cap. 0.1uf, same as C3			
C18	Cap. 0.1uf, same as C2			
C19	Cap. 0.1uf, same as C2			
C20	Cap. 0.1uf, same as C2			
C21	Cap. 0.01uf, same as C1			
C22	Cap. 0.1uf, same as C3			
C23	Cap. 0.1uf, same as C2			
C24	Cap. 0.1uf, same as C2			
C25	Cap. 0.01uf, same as C1			
CR1	Semiconductor Device, Diode	1N277	Y	3
FL1	Filter, Bandpass 2215 KHz 100 Hz BW When Used	3121FL1-106	U	1
FL1	Filter, Bandpass 2215 KHz 250 Hz BW When Used	3121FL1	U	1
FL2	Filter, Bandpass 2215 KHz 2500 Hz BW	3121FL2	U	1
L1	Coil, RF 1.0 MH	U102	AC	*
L2	Coil, RF 1.0 MH, same as L1			
L3	Coil, RF 1.0 MH, same as L1			
Q1	Semiconductor Device, Transistor, NPN	RC3710	U	*
Q2	Semiconductor Device, Transistor, Same as Q1			
Q3	Semiconductor Device, Transistor, Same as Q1			
Q4	Semiconductor Device, Transistor, Same as Q1			
Q5	Semiconductor Device, Transistor, Same as Q1			

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A4 (continued)			
Q6	Semiconductor Device, Transistor, Same as Q1			
Q7	Semiconductor Device, Transistor, Same as Q1 (See Note 1)			
Q8	Semiconductor Device, Transistor, Same as Q1			
R1	Res. 200Ω ½W ±5% carbon	RC20GF201J	A	1
R2	Res. 6200Ω ½W ±5% carbon	RC20GF622J	A	1
R3	Res. 4300 Ω ½W ±5% carbon	RC20GF432J	A	1
R4	Res. 10K ½W ±5% carbon	RC20GF103J	A	*
R5	Res. 68Ω ½W ±5% carbon (See Note 1)	RC20GF680J	A	
R6	Res. 680Ω ½W ±5% carbon	RC20GF681J	A	*
R7	Res. 10K, same as R4			
R8	Res. 2700Ω ½W ±5% carbon	RC20GF272J	A	*
R9	Res. 3900Ω ½W ±5% carbon	RC20GF392J	A	3
R10	Res. 390Ω ½W ±5% carbon	RC20GF391J	A	3
R11	Res. 680Ω, same as R6			
R12	Res. 1100Ω ½W ±5% carbon	RC20GF112J	A	1
R13	Res. 47K ½W ±5% carbon	RC20GF473J	A	1
R14	Res. 18K ½W ±5% carbon	RC20GF183J	A	1
R15	Res. 10K, same as R4			
R16	Res. 3900Ω, same as R9			
R17	Res. 1000Ω ½W ±5% carbon	RC20GF102J	A	*
R18	Not Used			
R19	Res. 10K, same as R4			
R20	Res. 4700Ω ½W ±5% carbon	RC20GF472J	A	4
R21	Res. 1000Ω, same as R17 (See Note 1)			
R22	Res. 10K, same as R4			
R23	Res. 2200Ω ½W ±5% carbon	RC20GF222J	A	*
R24	Res. 390Ω, same as R10			
R25	Res. 10K, same as R4			
R26	Res. 27K ½W ±5% carbon	RC20GF273J	A	1
R27	Res. 1000Ω, same as R17			
R28	Res. 10K, same as R4			
R29	Res. 3300Ω ½W ±5% carbon	RC20GF332J	A	*
R30	Res. 2700Ω, same as R8			
R31	Res. 390Ω, same as R10			
R32	Res. 680Ω, same as R6			
R33	Res. 1000Ω Min., 3000Ω Max. ½W ±5% carbon, When Used	RC20GF J	A	1
R34	Res. 12K ½W ±5% carbon, When Used	RC20GF123J	A	1
S4	Switch, Rotary	3121S4	U	1
	Note 1: Value selected to give proper CAL LEVEL range.			

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A4 (continued)			
T1	Transformer, IF 2.215 MC	B3807	AK	3
T2	Transformer, IF, same as T1			
T3	Transformer, IF, same as T1			

PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A5			
C1	Cap. 10uf -10 +100% 15 WVDC dry electrolytic	30D106G015BA2	AF	*
C2	Cap. 100uf -10 +100% 30 WVDC fry electrolytic	11-85PSS100-30S	AE	1
C3	Cap. 0.1uf ±10% 200 WVDC metalized mylar	210B1C104K	H	*
C4	Cap. 200uuf ±5% 500 WVDC silver mica	DM15E201J	I	1
C5	Cap. 0.1uf -20 +80% 25 WVDC disc ceramic	5815Y5U104Z	L	*
C6	Cap. 59uuf ±5% 500 WVDC silver mica	DM15E590J	I	1
C7	Cap. 0.01uf ±20% 200 WVDC disc ceramic	0805030Z5U00103M	L	*
C8	Cap. 0.01uf, same as C7			
C9	Cap. 0.01uf, same as C7			
C10	Cap. 0.01uf, same as C7			
C11	Cap. 0.1uf, same as C5			
C12	Cap. 0.01uf, same as C7			
C13	Cap. 0.01uf, same as C7			
C14	Cap. .001uf ±20% 500 WVDC disc ceramic	831000Z5U00102M	L	1
C15	Cap. 10uf ±20% 10 WVDC tantalum	K10W10	AL	1
C16	Cap. 10uf, same as C1			
C17	Cap. 22uf ±20% 6WVDC tantalum	K22W6	AL	1
C18	Cap. 0.1uf, same as C5			
CR1	Semiconductor Device, Diode	SM210	V	1
CR2	Semiconductor Device, Diode	1N277	Y	*
CR3	Semiconductor Device, Diode, same as CR2			
IC1	Intergrated Circuit	PA237	N	1
L1	Coil, RF 1.0 MH	U102	AC	*
Q1	Semiconductor Device, Transistor NPN	2N3053	AI	1
Q2	Semiconductor Device, Transistor NPN	RC3710	U	*
Q3	Semiconductor Device, Transistor, same as Q2			
Q4	Semiconductor Device, Transistor, same as Q2			
Q5	Semiconductor Device, Transistor, same as Q2			
R1	Res. 1000Ω ½W ±5% carbon	RC20GF102J	A	*
R2	Res. 820Ω ½W ±5% carbon	RC20GF821J	A	2
R3	Res. 68Ω 2W ±5% carbon	RC42GF680J	A	1
R4	Res. 60.4K ¼W ±1% Metal Film	RY60D60R4F	U	1
R5	Res. 10K ½W ±5% carbon	RC20GF103J	A	*
R6	Res. 2000Ω ½W ±5% carbon	RC20GF202J	A	1
R7	Res. 4700Ω ½W ±5% carbon	RC20GF472J	A	*
R8	Res. 1000Ω, same as R1			
R9	Res. 8200Ω ½W ±5% carbon	RC20GF822J	A	1

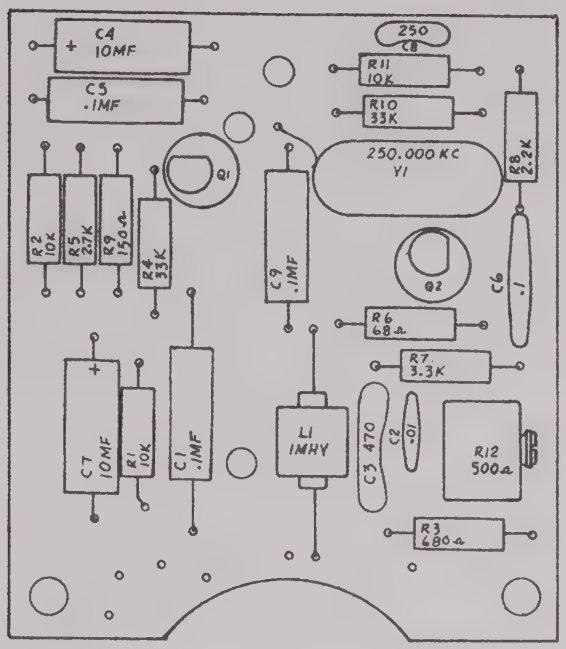
PARTS LIST

Sym	Description	Part No.	Mfr	Tot Qty
	Module A5 (continued)			
R10	Res. 2200Ω ½W ±5% carbon	RC20GF222J	A	*
R11	Res. 1000Ω, same as R1			
R12	Res. 1000Ω, same as R1			
R13	Res. 4700Ω, same as R7			
R14	Res. 4700Ω, same as R7			
R15	Res. 3900Ω ½W ±5% carbon	RC20GF392J	A	*
R16	Res. 15K ½W ±5% carbon	RC20GF153J	A	3
R17	Res. 150K ½W ±5% carbon	RC20GF154J	A	1
R18	Res. 15K, same as R16			
R19	Res. 820Ω, same as R2			
R20	Res. 390K ½W ±5% carbon	RC20GF394J	A	1
R21	Res. 56K ½W ±5% carbon	RC20GF563J	A	2
R22	Res. 15K, same as R16			
R23	Res. 56K, same as R21			
R24	Res. 180K ½W ±5% carbon	RC20GF184J	A	1
S5	Switch, Rotary	3121S5	U	1
VR1	Semiconductor Device, Diode	1N960B	D	1
Y1	Crystal 2213.5 KHz	159	K	1
Y2	Crystal 2216.5 KHz	160	K	1

PARTS LIST

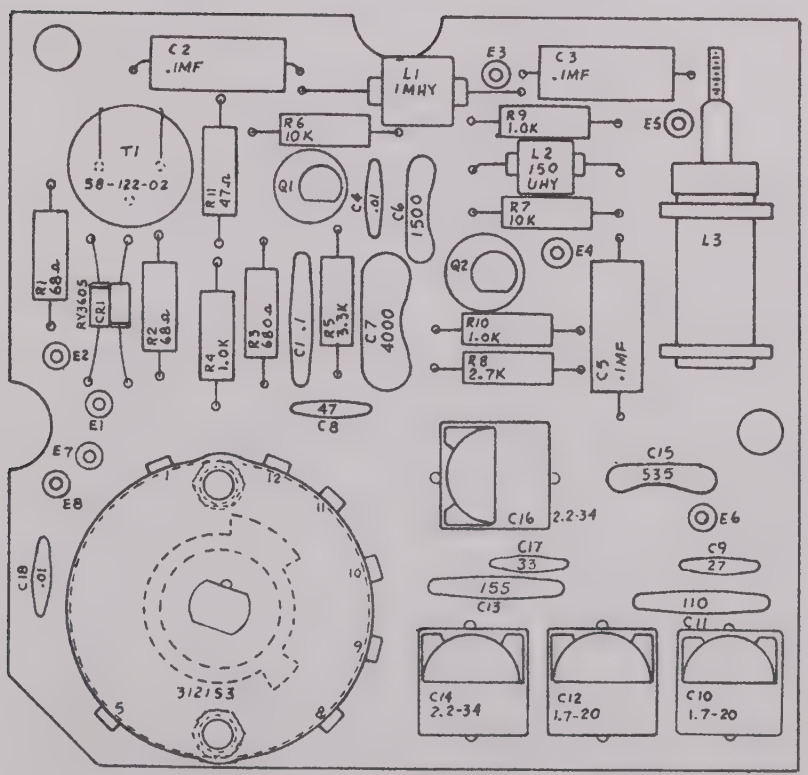
Sym	Description	Part No.	Mfr	Tot Qty
	Miscellaneous			
BT1	Battery 12V 1.2 ah nickel cadmium	41B001KD20	N	1
C1	Cap. Var. Air 11-150uuf	167-153-10	F	1
FL3	Filter, Lowpass	3121FL3	U	1
J1	Connector, electrical power	H1061	AA	1
J2	Jack, Headset	L-12A	X	1
L1	Coil, RF, 15.6uh	3121L1A	U	1
L2	Not Used			
L3	Not Used			
L4	Suppressor, Parasitic	3121L4	U	1
LS1	Loudspeaker	S8837	T	1
M1	Multimeter, Replacement	3005-41	U	1
R1	Res. Var. 25K ½W ±30% with S7	PF3890	C	1
R2	Res. Var. 10K ½W ±30%	NW8746	C	1
R3	Res. 47Ω ±5% ½W carbon	RC20GF470J	A	1
S6	Switch SPDT Push-button momentary	903	X	1
S7	Switch SPST Push-pull part of R1			*
T1	Transformer, Power	3121T1	U	1
WA	Cable Assembly, Power	17258S	B	1

NOTES



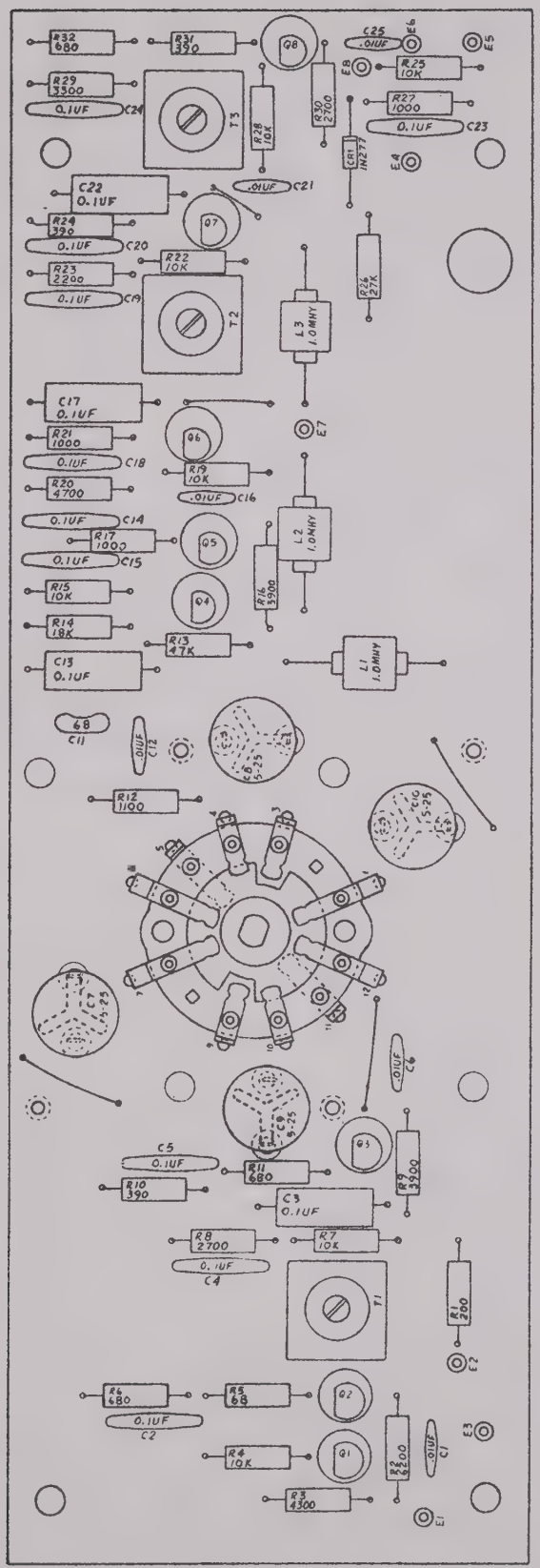
TERM	WIRE COLOR
1	GR
4	GR-W
5	R-WH
6, 7	COAX
8	R

Figure 8. Module A2



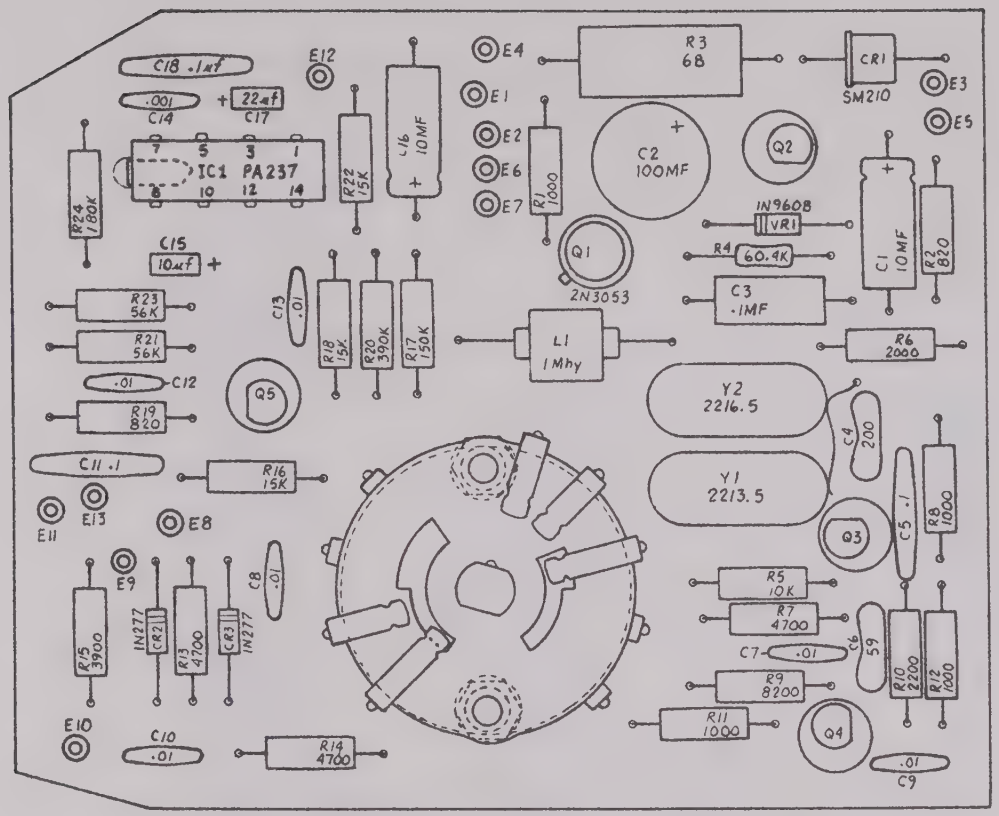
TERM	WIRE COLOR
E1, E2	COAX
E3	L4
E4	BUS
E5	BUS
E6	BUS

Figure 9. Module A3



TERM	WIRE COLOR
E1	R
E2	COAX
E3	BUS
E4	Y-WH
E5	V-WH
E7	R
E6, E8	COAX

Figure 10. Module A4



TERM	WIRE COLOR
E1	RED - BLK
E2	RED
E3	GRN
E4	RED - WHT
E5	ORN
E6	RED
E7	RED
E8	COAX
E9	COAX
E10	GRN
E11	GRN -WHT
E12	BLU
E13	BLK

Figure 11. Module A5

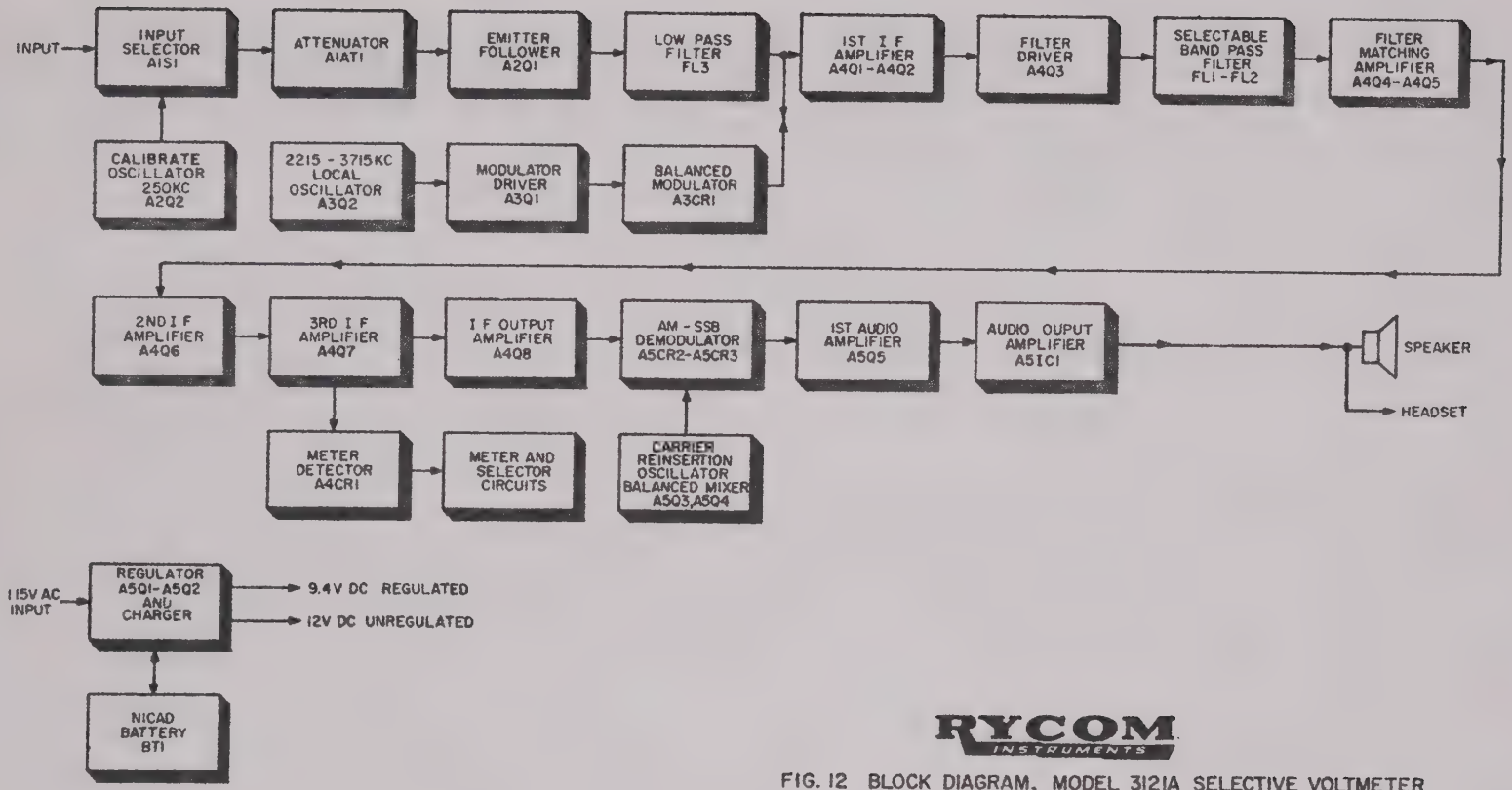


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FIG. 12 BLOCK DIAGRAM, MODEL 3121A SELECTIVE VOLTMETER

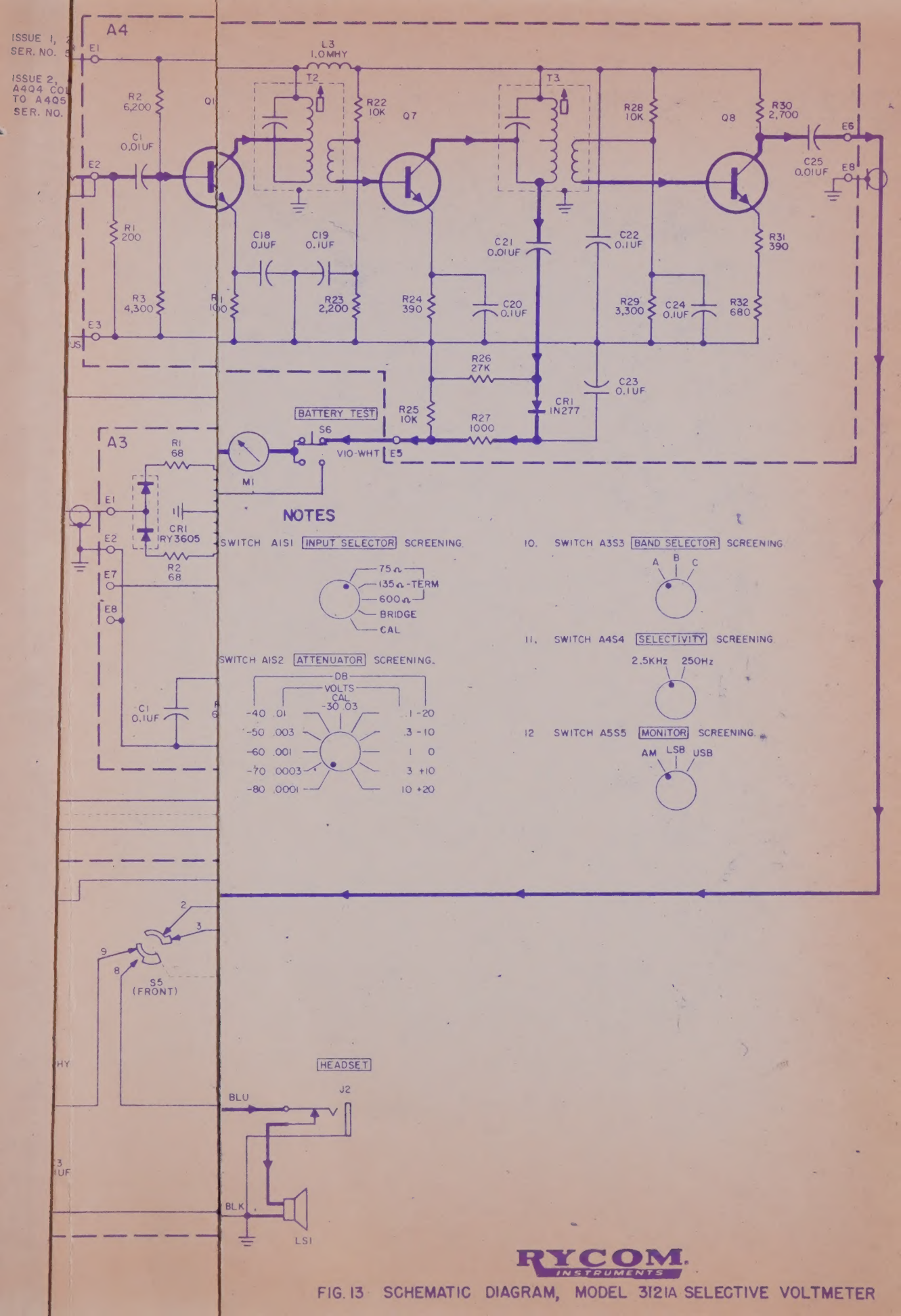

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FIG. 13 SCHEMATIC DIAGRAM, MODEL 3121A SELECTIVE VOLTMETER